

# GSFC: Technical Lessons Learned in Trans-Pacific Demonstration (TPD)

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# Rational For Mentat SkyX Gateway

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- Visible Human Slice Server (VHSS)
  - » Developed on an Apple Macintosh G3 with MacOS X
    - Unable to increase TCP window size beyond 64KB on MacOS X
  - » Uses TCP sockets to transfer data
- Early test over 45 Mbps ATM path with simulated two geosynchronous satellite links using 64KB TCP window

| Path    | Via       | SkyX<br>Proc | RTT (ms)<br>65B/1500B | #Hopws<br>-><- | ftp (Mbps)<br>15KB/32KB | nttcp (Mbps)<br>7MB |
|---------|-----------|--------------|-----------------------|----------------|-------------------------|---------------------|
| ARC-NLM | Simulated | NO           | 1171/1172             | 2/2            | .027/.155               | 0.203               |

- TCP window formula predicts 5.855 MB window is needed

$$\begin{aligned}\text{TCP window} &= ((\text{bandwidth in Mb/s}) * \text{RTT}) / (8 \text{ bits/byte}) \\ &= 45 * 1.172 / 8 = 5.855 \text{ MBytes}\end{aligned}$$

# Rational For Mentat SkyX Gateway (continued)

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- SkyX Gateway system between SkyX Gateways replaces TCP with a protocol optimized for the long latency, high loss, asymmetric bandwidth conditions typical of satellite communications
- SkyX Gateway solution is transparent to the end users
  - » Does not require modifications to end clients and servers
- SkyX Gateway solution is transparent to IP networks
  - » SkyX protocol encapsulated inside IP packet

# SkyX Related Routing Issues

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- SkyX Gateway has two Fast Ethernet (FE) interfaces
  - » Can be configured to use only one as a one-armed gateway
- SkyX Gateway at SMU placed between router connected via FE to satellite modem and SMU's VH LAN
- SkyX Gateway on Canadian/U.S. side was placed at GSFC
  - » Router in Canada connected to satellite modem connected to ATM network on path to NLM, thus FE connection did not exist at this connection point
  - » Two test systems at GSFC, an ATM-attached host at NLM, and a FE-attached host at NLM were to be included in the SkyX testing
    - Static routes used to force path through SkyX Gateway for these hosts
    - SkyX Gateway was set up as one-armed gateway to avoid placing it between the router and various semi-production LAN's hosting the systems used in the SkyX testing
      - Tests verified that the SkyX Gateway running in one-armed mode could more than handle the I/O rates needed for this demo

# SkyX Gateway Tuning Issues

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- Easy to configure if delay and rate values are known
- Problems caused by misunderstanding of configuration settings affecting the bandwidth
- Assistance from Mentat in use of undocumented command to limit the bandwidth on the SkyX Gateway
  - » Helped determine the effective bandwidth to be 16-17 Mbps
    - Helped discover that, when a second PVC was added, the 45 Mbps PVC had been converted into two 20 Mbps PVCs

# GSFC - Benchmark Test Script

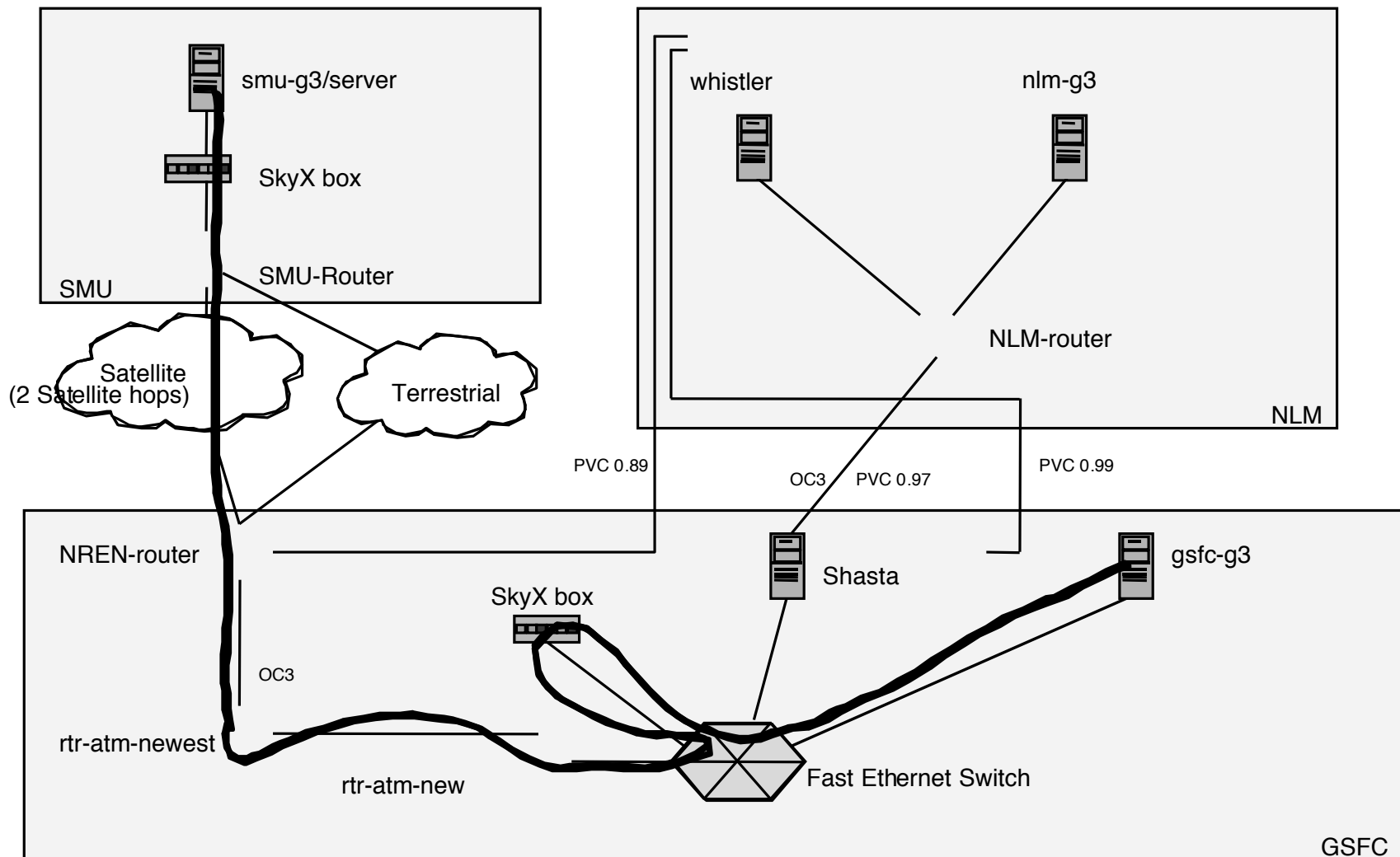
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- Written to check and save information on the characteristics of the link prior to each Visible Human Viewer test run
- Test Script Checks
  - » Roundtrip time (RTT) (using ping with small and large packet sizes)
  - » Router hops (traceroute with small and large packets in both directions)
  - » Transfer rates (ftp and nttcp of 7MB of data (size of largest image))

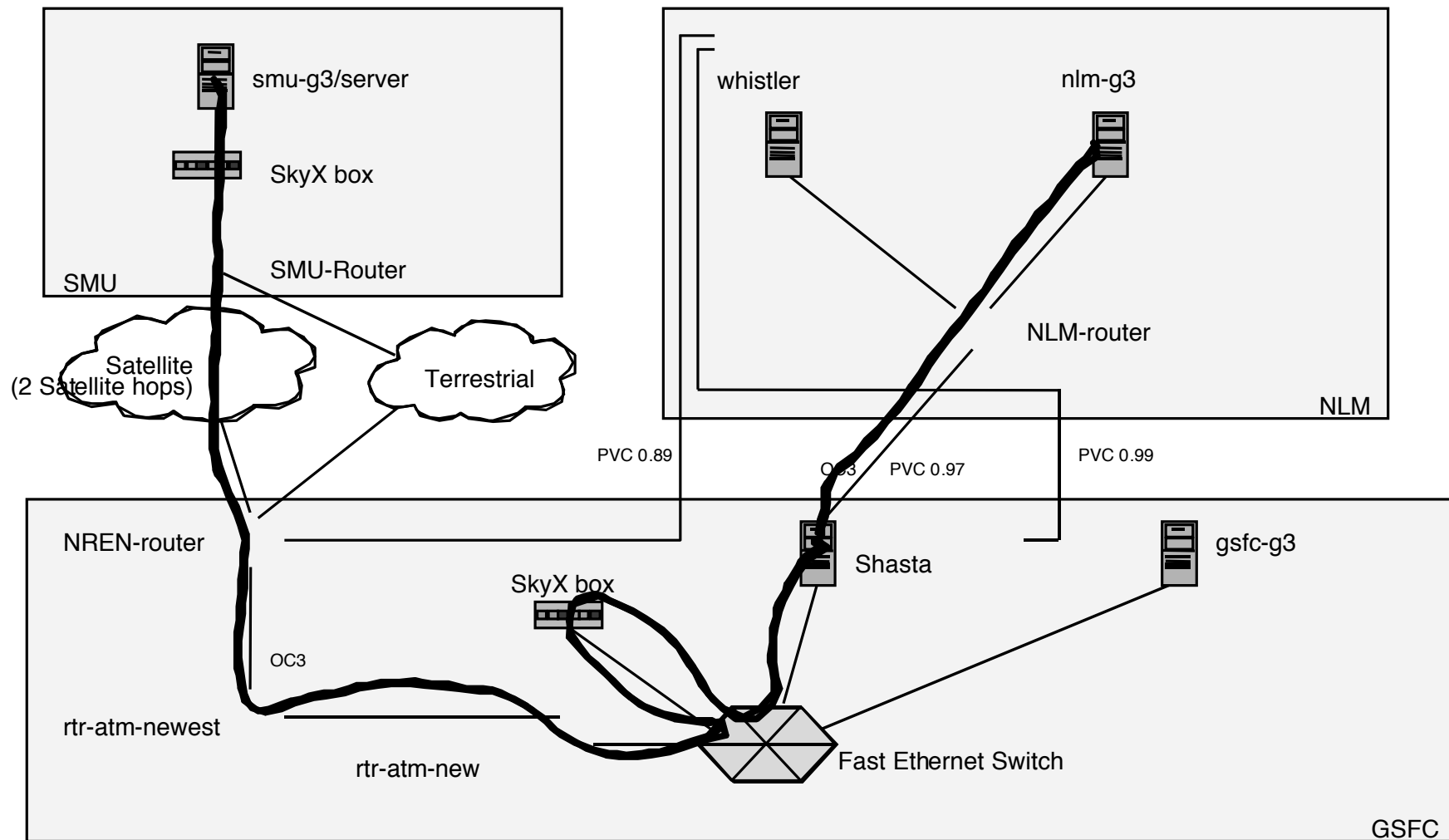
| Path# | Path     | Via      | SkyX<br>Proc | RTT (ms)<br>65B/1500B | #Hops<br>-> <- | ftp (Mbps)<br>15KB/7MB | nttcp (Mbps)<br>7MB |
|-------|----------|----------|--------------|-----------------------|----------------|------------------------|---------------------|
| 1     | SMU-GSFC | Intelsat | Yes          | 1124/1127             | 14/14          | /15.2                  | 11.9                |
| 2     | SMU-NLM  | Intelsat | Yes          | 1127/1130             | 16/16          | 10.9/15.2              | 11.9                |
| 3     | SMU-NLM  | Intelsat | No           | 1127/1130             | 16/16          | .026/.224              | 0.225               |
| 4     | SMU-GSFC | TransPAC | No           | 191/224               | 16/14          | /.817                  | 0.732               |

where Intelsat is the satellite path and TransPAC is the terrestrial path

# SkyX Gateway Network Configuration for VH Testing Path #1

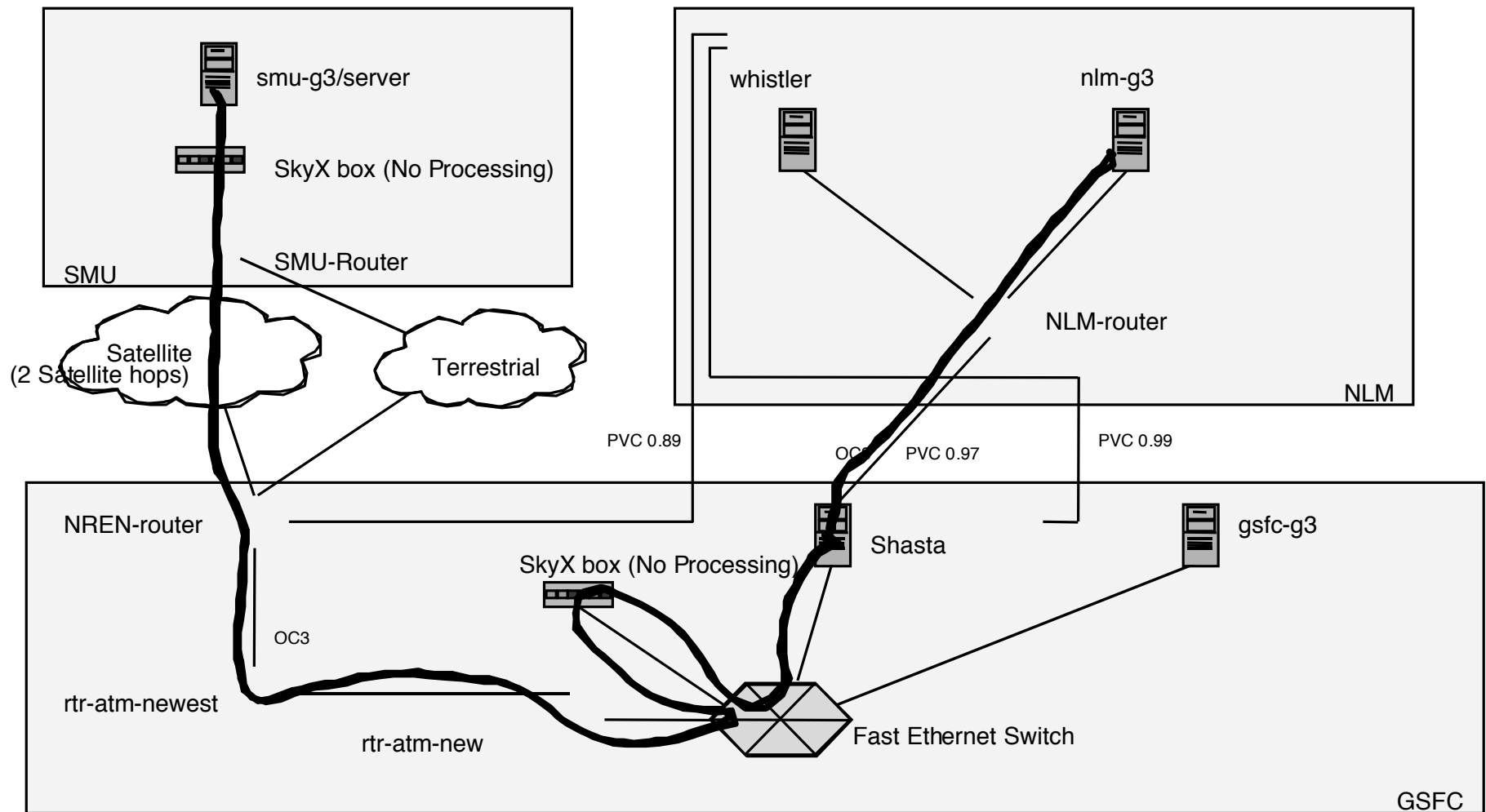


# SkyX Gateway Network Configuration for VH Testing Path #2

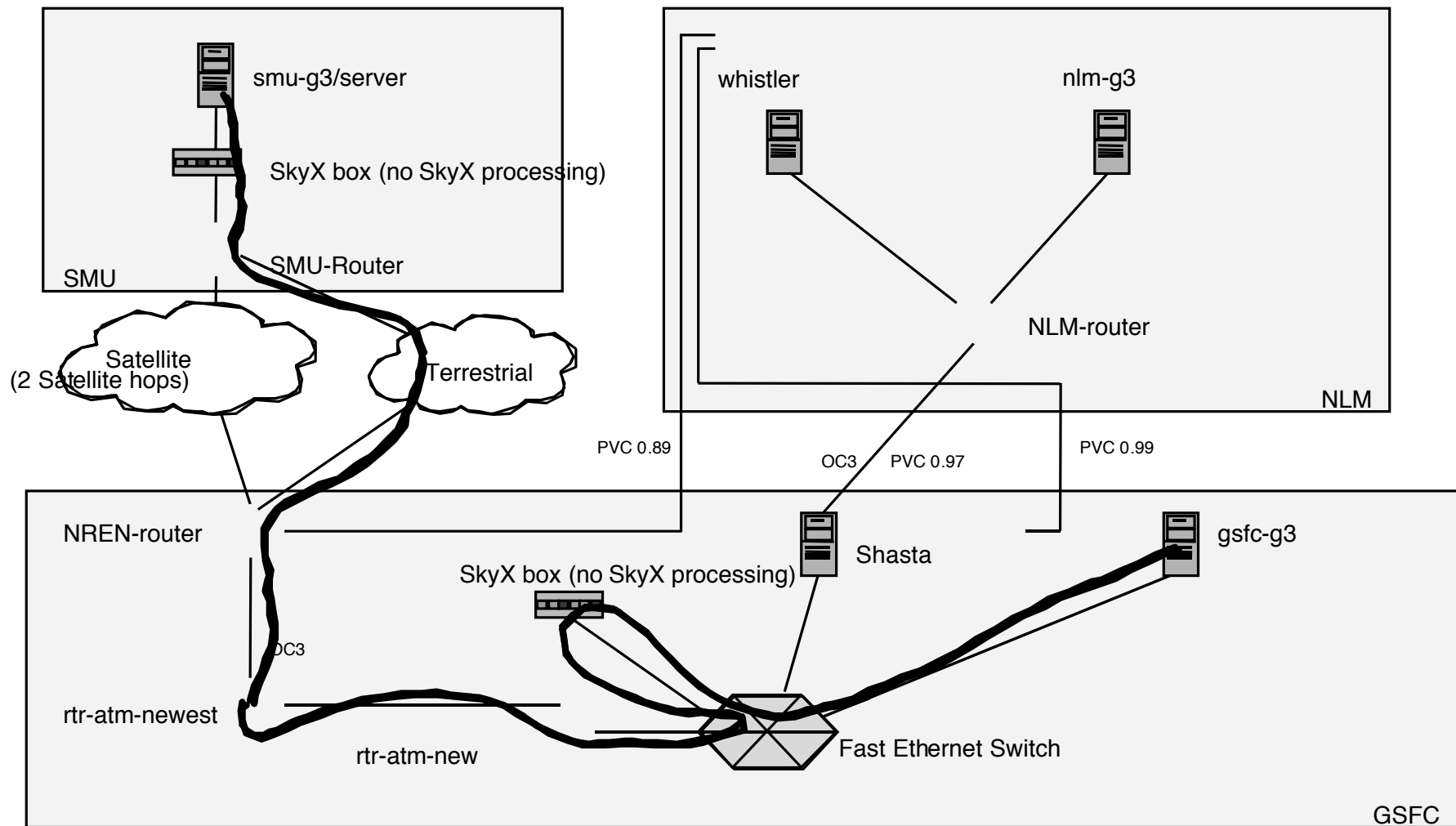




# SkyX Gateway Network Configuration for VH Testing Path #3



# SkyX Gateway Network Configuration for VH Testing Path #4



# GSFC - Troubleshooting

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- Complicated by differences in Time-Zones/International Date Line, languages, holidays, additional work loads, number of networks/groups/organizations involved, and mixture of technologies.
- Use of traceroutes helped determine when a loopback had been left in place, as the last router before the loop would repeat in the traceroute

# GSFC - Troubleshooting (continued)

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- Use of small and large packet ping and traceroute, and archiving the results, help isolate when and where a burst rate configuration problem was introduced that affected the transmission of large (around 1300 byte or larger) packets
  - » Initially small and large packet pings and traceroutes had worked in both directions
    - Link problem was noticed when only small packets worked in both directions
      - Large pings didn't work and large packet traceroutes completed in one direction and only made it part way in the other direction
      - For traceroute the large packet is not echoed, a small host unreachable packet is returned instead
    - Further narrowed down the problem by setting up loopbacks on the PVC on different switches and then checking the ping using large packets

# Personal File System (PFS)

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- Rational for using PFS
  - » Special demo in Japan retrieved slice images via Network File System (NFS) had poor performance
    - NFS uses its own windowing mechanism and therefore is not aided by SkyX processing
    - Not able to change NFS parameters under MacOS X to improve performance
  - » PFS has a cache storage on the client, and dynamically adapts for a variety of network speeds and bandwidths

# Personal File System (continued)

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- NFS vs PFS Test results

7471284 byte downloads:

|                 | kbps           | seconds     |
|-----------------|----------------|-------------|
|                 | min/avg/max    | min/avg/max |
|                 | -----          | -----       |
| NFS Terrestrial | 158/ 469/ 592  | 101/137/379 |
| NFS Satellites  | 144/ 214/ 292  | 205/238/416 |
| PFS Terrestrial | 787/ 885/ 933  | 64/ 68/ 76  |
| PFS Satellites  | 1928/5369/8414 | 7/ 12/ 31   |

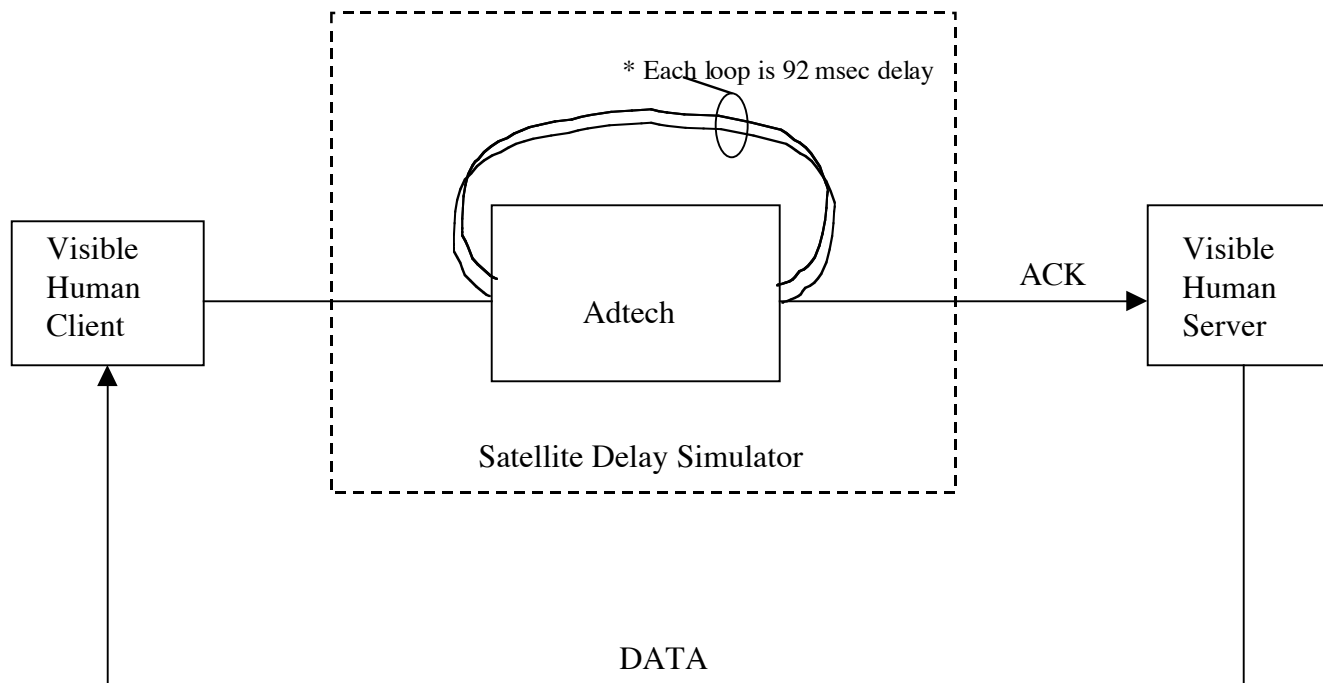
Note: Terrestrial goes through a shared T1 link

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# Appendix

# GSFC Satellite Delay Simulator

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\* need 12 passes (11 loops) to simulate the delay in a two hop satellite connection (1.1 second delay)